

Effective Retrieval of Lyme Disease Information on the Web

Sunil K. Sood

Pediatric Infectious Diseases, Schneider Children's Hospital at North Shore, Manhasset, and Albert Einstein College of Medicine, Yeshiva University, Bronx, New York

The spirochetal infection Lyme disease, although now usually easily diagnosed and treated, has acquired an aura of ambiguity for many laypersons and medical professionals. The existence of controversy makes it difficult for infectious diseases physicians and scientists to readily obtain accurate information on Lyme disease by casually browsing the World Wide Web. Informative and current Web sites on the diagnosis, epidemiology, treatment, and prevention of Lyme disease can be found on-line, as can clear images of its clinical variants and of ticks. There are a handful of on-line resources on the biology of *Borrelia* and ticks, which can be tapped by the research community. These Web sites are described in the present article.

In a manner that is, perhaps, unique among infectious diseases, Lyme disease has acquired a life of its own on the Internet. As any infectious diseases physician who practices in an area in which Lyme disease is endemic can attest, the World Wide Web is a primary medium for patients seeking information on Lyme disease, one to which they often refer before seeking medical consultation and treatment. Misconceptions about the disease, in particular the incidence of chronic Lyme disease, the alleged difficulty of diagnosis, and the perceived need for a prolonged course of antibiotics, have been amplified on the Web. Searches on popular engines bring up numerous personal Web pages containing poorly substantiated information. Some of these are painstaking compendia of links to publications by experts that are described as sources not to be believed. Some support-group sites artfully direct patients to unscientific information. The profusion of information makes finding relevant and authoritative Web sites on Lyme disease a time-consuming exercise. The present article is a guide to scientifically rigorous and useful English-language clinical and research resources on the Web.

In a recent Roper organization survey, respondents said that they most often learned about health-related Web sites through search engines or through links from other sites that they had visited [1]. Health care professionals were rarely cited as a

source of information about reliable Web sites. The infectious diseases physician, however, should be able to direct patients to reliable Web sites on Lyme disease.

The sites recommended here are produced by a variety of organizations, agencies, and societies. The Web sites of public health agencies, notably the Centers for Disease Control and Prevention (CDC), can be relied on to provide objective, scientifically validated information. However, the search term "Lyme disease" most commonly brings up foundations and support-group sites that educate but also play an advocacy role. On a recent search on the Lycos search engine, the CDC home page on Lyme disease was number 129 on the list of sites, making it unlikely that a casual browser would find it. The CDC is not the only comprehensive source, but it should be noted that most other recommended Web sites, including many state health department sites, prominently list links to several sites that are scientifically inadequate. As an example, a compilation from the Yale Medical Library (not included here) has links to several Web sites that contain misleading information, while failing to highlight Yale's own cutting-edge research in Lyme disease.

METHODS

It is easy to begin a search of Web sites on Lyme disease, because this is the medical term used almost exclusively for the disease in consumer education, as well as scientific, literature. Use of *Borrelia* or Lyme borreliosis as an alternate search term does not yield additional scientifically sound sites. A search for "Lyme disease" on the Google search engine resulted in ~200,000 hits,

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Reprints or correspondence: Dr. Sunil Sood, North Shore University Hospital, 9 Tower, 300 Community Dr., Manhasset, NY 11030.

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but extensive perusal of sites on this and other search engines yielded similar sites of good scientific quality. Personal pages were excluded from the final selections, as were sites of organizations that gave misinformation on the home page. Only a very small fraction of sites on Lyme disease are sources of high-quality information, and, in this author's opinion, these are the only sites an infectious diseases specialist needs to use.

As with any other medium, authorship inevitably influences the veracity, bias, and depth of information on a Web site. Therefore, each site chosen for review was classified into an authorship category, as follows: professional organization or society; public health agency; patient education by private organization or hospital; pharmaceutical company, commercial laboratory, or consumer products manufacturer; or journal, book, or other literature compilation. An abbreviated name for each category is listed under "Source type" ("professional," "public," "patient education," "commercial," or "literature") in the first column of the tables accompanying this article, to give the user the option of choosing the sites with which to begin his or her quest. Multiple sites that link to the same information are listed in some cases, because access to a site or journal's full text may vary with the user's professional affiliations and subscriptions.

Each site was evaluated with a review sheet that was loosely based on the criteria for Web page evaluation previously described in this journal [2, 3]. Each site was accessed at least 3 times during a 6-month period to gauge the currency of updates and reliability of the links. The source type was identified, and the following features were evaluated: level of information (basic facts only, comprehensive guide, or research-quality site); quality of information, as assessed by whether the authorship is expert or the author's expertise is unstated, whether attribution of sources is present or absent, whether potential financial or other vested interests are disclosed, and whether the site is current in its information; usability of the Web site (layout and graphics, minimal requirement for horizontal/vertical scrolling, presence of a site directory, use of hypertext to structure large bodies of content, and use of standard link colors [blue for unvisited links, red/purple for visited links]); activity of all links and the quality of the information to which they lead; and availability of a search option. The type of information that an infectious diseases specialist would seek was categorized on the basis of an article on tuberculosis resources previously published in this series [4].

RESULTS

Approximately 55 sites with useful and scientifically sound information were found, most of which provide access to clinical and diagnostic information. Several sites with information on ticks were found. All available literature retrieval resources were not explored, but several free services that yielded relevant stud-

ies are listed. The most common source type was "public," followed by "professional" and "literature."

DISCUSSION

Clinical features and diagnosis. Web sources for clinical information on disease recognition and laboratory diagnosis are listed in table 1. The Lyme disease home page of the CDC's Division of Vector-Borne Infectious Diseases (DVBID) provides concise and objective information (figure 1). As an agency that serves the public, the CDC targets information toward both the layperson and the scientific community. The site is aesthetically pleasing and is structured for efficient browsing. The authorship is expert, in that the DVBID scientists and CDC epidemiologists who contribute to the site work, in many cases, exclusively in the field of tickborne diseases. The bibliography of medical literature (accessible through the link "Scientific Literature") is well chosen and comprehensive. A handy feature of the bibliography pages is the provision of links to hypertext and portable document format (PDF) versions of key *Morbidity and Mortality Weekly Report* (MMWR) documents. Specific sections of this Web site that are useful resources for epidemiology and tick biology are listed separately in relevant tables in the present article. The CDC's Lyme disease home page also contains a link to a description of a new disease, Southern tick-associated rash illness, and links to the Division of Viral and Rickettsial Diseases for information on other tickborne diseases.

The Web can be a tremendous resource for pictorial diagnostic aids, and these can be useful in treating patients with Lyme disease because of the many variations in the appearance of erythema migrans. The European Union Concerted Action on Lyme Borreliosis (EUCALB) Web site (figure 2) and an interactive on-line seminar from *The Lancet* [5] provide excellent digital images of erythema migrans rashes. The EUCALB site also has pictures of the skin manifestations acrodermatitis, chronica atrophicans, and borrelial lymphocytoma, which are seen exclusively in Europe.

Table 1 lists addresses for the Web sites of journals that have recently published review articles that contain clinical information on the disease. The *Lancet* seminar by Nadelman and Wormser is a hypertext-structured comprehensive reference that includes color graphics [5]. The extra steps involved in obtaining access to it are worth the effort. The American Lyme Disease Foundation's Web site (<http://www.aldf.com>) is primarily an education resource for patients, but the section "News from the Front" highlights many recent studies that the infectious diseases physician would want to peruse. A very concise patient's guide hosted by Pfizer Global Research is available at <http://www.lymediseaseinformation.com>, and a Lyme disease pamphlet can be ordered through the site.

Despite the accumulation of a wealth of experience with

Table 1. Web sources for clinical information on recognition and laboratory diagnosis of Lyme disease.

Source type	Title or subject	Address	Source name or publisher	Comment
Public	Diagnosis	http://www.cdc.gov/ncidod/dvbid/lyme/diagnosis.htm	CDC DBVID	Historical summary and description of Lyme disease
Professional	Medical images	http://www.dis.strath.ac.uk/vie/LymeEU/images_medical.html	EUCALB	Exceptionally well edited and compiled
Literature	On-line seminar	http://www.thelancet.com	<i>The Lancet</i>	Comprehensive review [5]; free access through search page by registration when prompted
Literature	Lyme disease (medical progress article)	http://content.nejm.org/cgi/content/full/345/2/115	<i>The New England Journal of Medicine</i>	Useful for author's expert opinions [6]
Literature	Lyme disease (CME article)	http://www.pidj.org or http://www.pidj.com	<i>Pediatric Infectious Disease Journal</i>	Useful for information about Lyme disease in children and table on serologic diagnosis [7]
Public	Laboratory diagnosis recommendations	http://www.cdc.gov/mmwr/preview/mmwrhtml/00038469.htm	CDC DBVID	Helps understand rationale for immunoblot
Professional	Laboratory evaluation in the diagnosis of Lyme disease	http://www.acponline.org/journals/annals/15dec97/pplyme1.htm	ACP	Clinical guideline document
Commercial	Specialty Laboratories Lyme disease tests	http://www.specialtylabs.com/education/download_PDF/TN_1087.pdf	Specialty Laboratories	PDF documents with references
Commercial	Information on newest licensed antibody test	http://www.immunetics.com/products/human/C6Bburg.html	Immunetics	Detailed background on C6 peptide antibody assay that does not cross-react with OspA (vaccine) antibody
Commercial	Information on licensed antibody test	http://www.chembio.com/news.html	Wampole Laboratories	Information on this CLIA-waived test

NOTE. ACP, American College of Physicians; CDC, Centers for Disease Control and Prevention; CLIA, Clinical Laboratory Improvement Amendments; CME, continuing medical education; DBVID, Division of Vector-Borne Infectious Diseases; EUCALB, European Union Concerted Action on Lyme Borreliosis; OspA, outer-surface protein A; PDF, portable document format.

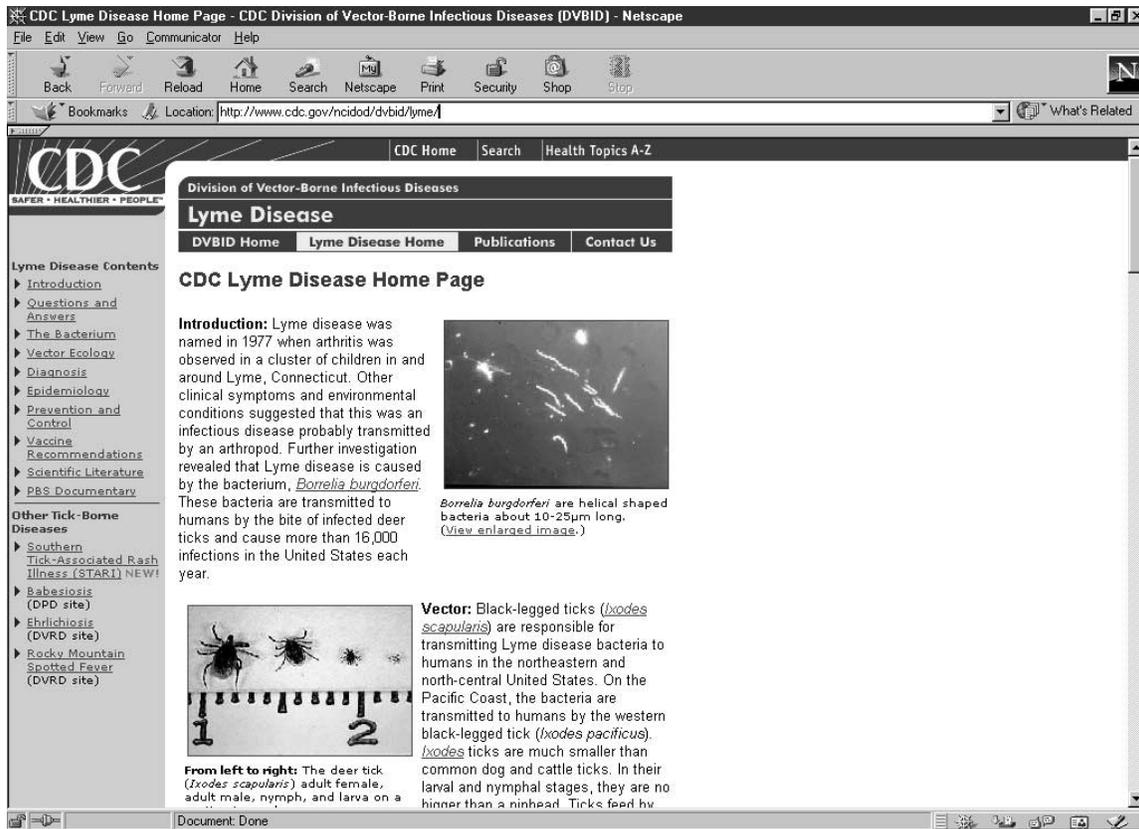


Figure 1. Centers for Disease Control and Prevention home page on Lyme disease: <http://www.cdc.gov/ncidod/dvbid/lyme/index.htm>

laboratory diagnosis of Lyme disease in areas of endemicity, many physicians continue to be skeptical about the reliability of laboratory diagnostic methods and are unfamiliar with the criteria for interpreting immunoblot results in *Borrelia burgdorferi* infection. The MMWR recommendations from a broad-ranging consensus conference in 1994 are easily accessible in the bibliography of the CDC's Web site. Information about the basis of and potential indications for use of 2 newer antibody tests (one of which is intended for office use) is available on the Immunetics and Wampole Laboratories Web sites, but a complete understanding of the role (if any) of these 2 tests in facilitating the diagnosis of Lyme disease requires a review of the original publications. Only those for the C6 peptide test are available, at http://www.specialtylabs.com/education/download_PDF/TN_1087.pdf. No objective review that would help further explain the role of these tests could be found on the Web. The "Questions and Answers" page from Specialty Laboratories for the C6 peptide test (http://www.specialtylabs.com/education/download_PDF/TN_1172.pdf) is instructive.

Epidemiology of Lyme disease. Table 2 lists sources of information about the epidemiology of Lyme disease. There is marked variation in the incidence of Lyme disease within regions of endemicity, ranging from no cases to hyperendemicity. National and local maps of disease incidence or

tick populations are useful guides that should be consulted when decisions about laboratory testing are made, because the predictive value of a test is enhanced by a higher prior probability. A calculator that can be used to calculate this is available on the American College of Physicians (ACP) Web site (<http://www.acponline.org/lyme/calculator/>). Detailed epidemiology information (for pretest probability estimates) is not available on-line for all regions, but some high-incidence states, notably Connecticut, have excellent pictorial or tabular guides on their health department Web pages. Among state health department sites, Connecticut's provides the best all-around information. Information on the biology of the deer tick life cycle and a National Lyme Disease Risk Map are excellent resources that are available from the CDC. The map represents a mathematical model constructed from information about tick prevalence, tick infection, and reported human cases. *Emerging Infectious Diseases*, a free journal from the CDC that is available on-line, is a noteworthy source of epidemiologic research on Lyme disease and other tickborne diseases.

Treatment recommendations. Table 3 lists sites with information about treatment of Lyme disease. The Infectious Diseases Society of America (IDSA) treatment recommendations were published in 2000 as a consensus statement by infectious diseases and rheumatology experts on Lyme disease [8]. IDSA

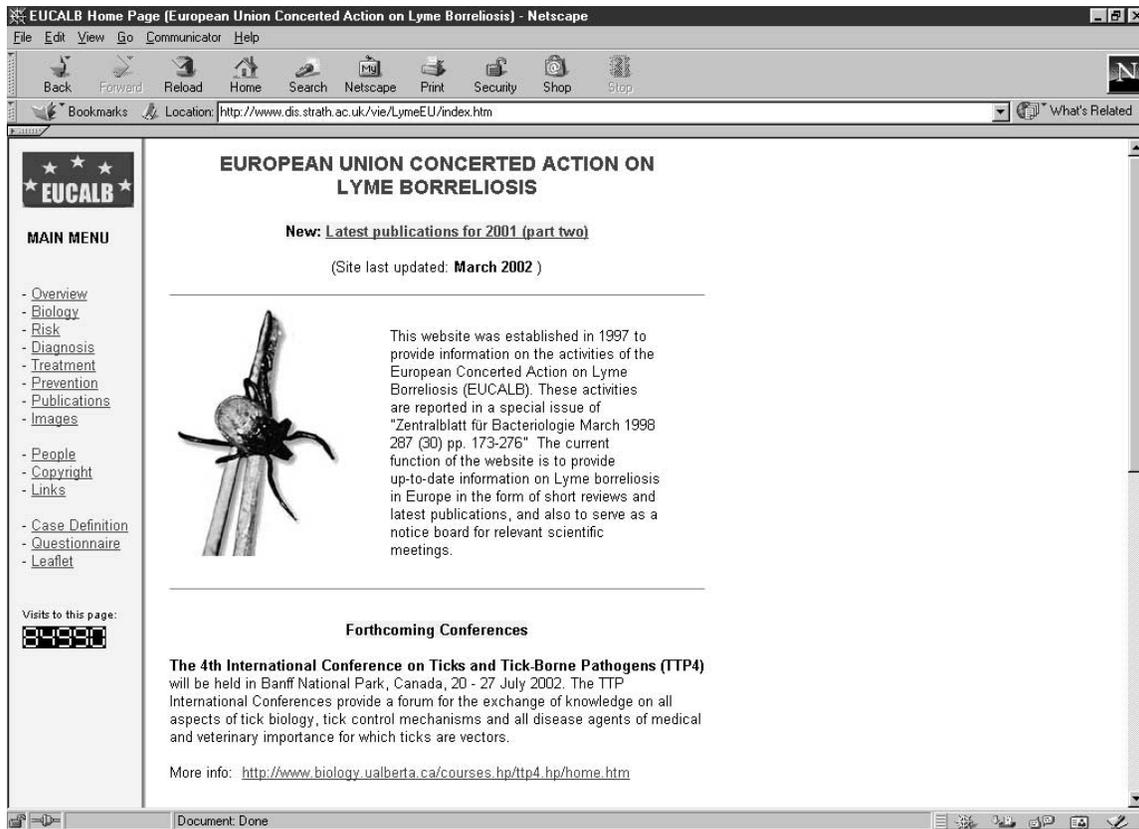


Figure 2. European Union Concerted Action on Lyme Borreliosis home page: <http://www.dis.strath.ac.uk/vie/LymeEU/index.htm>

members may access them via on-line subscriptions to *Clinical Infectious Diseases*, and pediatricians can view them via the American Academy of Pediatrics Web site. The recommendations are detailed and evidence based.

Evidence-Based Medicine Reviews (EBMR) is a valuable on-line resource for information on treatment and prevention studies in Lyme disease (figure 3). Infectious diseases practitioners may already be familiar with the Cochrane Database of Systematic Reviews and Cochrane Controlled Trials Register from the Cochrane Collaboration project, which provides compilation and critique of the best evidence from medical research that can be translated into clinical practice. EBMR identifies studies from Cochrane and 2 other evidenced-based medicine sources, the ACP Journal Club and the Database of Abstracts of Reviews of Effectiveness; it is a full-text database of reviews of key studies that can be used in making treatment decisions. Ovid/EBMR is a collaborative arrangement between EBMR and Ovid Technologies (<http://www.ovid.com> [select "All EBM Reviews"]; available via institutional subscription, typically through the infectious diseases physician's hospital or medical school library). When the database was searched in January 2002 (the EBMR database is updated quarterly), 58 citations were obtained (figure 3). These consisted of 52 controlled studies, 4 reviews of effectiveness, and 2 reviews from the ACP

Journal Club. Ovid MEDLINE is a subscription-based service that is generally available via hospital libraries; the service makes full-text links to articles from many journals available.

Information about ongoing clinical trials that are recruiting patients for studies of Lyme disease can be viewed at a National Institutes of Health (NIH) Web site devoted to these trials and at the Web site for CenterWatch, which also lists industry-sponsored trials. For example, as of January 2002, ongoing studies of Lyme disease were "A Comprehensive Clinical, Microbiological and Immunological Assessment of Patients with Suspected Chronic Lyme Infection and Selected Control Populations" and a study designed to document the natural history of rigorously defined, treated Lyme disease. The New Jersey Department of Health has a handy table of choices for treatment of tickborne diseases on its site (table 2).

Tick morphology and biology. Many infectious diseases physicians are interested in obtaining more information about ticks, and on-line sources are available to fill this need (table 4). A review of tickborne diseases, with images, was published in *The New England Journal of Medicine* in 1993 [9]. A very exhaustive recent review article on ticks and bacterial diseases transmitted by ticks worldwide can be accessed through the electronic edition of *Clinical Infectious Diseases* [10]. The University of California—Davis Entomology Department has a de-

Table 2. Web sources for information on the epidemiology of Lyme disease and disease reporting requirements.

Source type	Title or subject	Address	Source name or publisher	Comment
Public	"Vector Ecology"	http://www.cdc.gov/ncidod/dvbid/lyme/history.htm	CDC DVBID	Summary of ecological background of Lyme disease
Patient education	Reported Lyme disease cases and incidence	http://www.aldf.com/usmap.asp	ALDF	Elegant charts and maps
Public	National Lyme disease risk map	http://www.cdc.gov/mmwr/preview/mmwrhtml/rr4807a2.htm	CDC	Interactive map
Professional	ACP Initiative on Lyme Disease	http://www.acponline.org/lyme/	ACP-ASIM	Offers a probability calculator
Public	Lyme disease control	http://www.state.ma.us/dph/cdc/epii/lyme/lymehp.htm	Massachusetts Department of Public Health	Comprehensive
Public	"What You Should Know about Lyme Disease and Tickborne disease"	http://www.state.nj.us/health/cd/f_lyme.htm	New Jersey Department of Health and Senior Services	Comprehensive domestic tick-control guide; handy table of treatment choices for tickborne diseases
Public	"Lyme Disease Vaccine Recommendations for the Commonwealth of Pennsylvania"	http://www.health.state.pa.us/hpa/CDI/lymreom.htm	Pennsylvania Department of Health	Locally relevant modified ACIP vaccine use recommendations
Public	"Lyme Disease in Connecticut"	http://www.dph.state.ct.us/BCH/infectiousdise/tickborne/lyme.htm	Connecticut Department of Public Health	Best state site
Public	<i>Emerging Infectious Diseases</i> on-line	http://www.cdc.gov/ncidod/eid	CDC	Free on-line access to the journal

NOTE. ACIP, Advisory Committee on Immunization Practices; ACP, American College of Physicians; ALDF, American Lyme Disease Foundation; ASIM, American Society of Internal Medicine; CDC, Centers for Disease Control and Prevention; DVBID, Division of Vector-Borne Infectious Diseases.

Table 3. Web sources for Lyme disease treatment recommendations.

Source type	Title or subject	Address	Source name or publisher	Comment
Professional	Treatment recommendations of the IDSA	http://www.aap.org/policy/lymedis.html	AAP	Endorses IDSA recommendations
Professional	Treatment recommendations of the IDSA	http://www.journals.uchicago.edu/CID/journal/issues/v31nS1/000342/000342.html	IDSA; CID electronic edition	Official IDSA recommendations [8]
Literature	EBMR	http://gateway1.ovid.com/ovidweb.cgi (accessed via local medical center library's Web site)	Ovid Technologies	Several other Web sites offer access to EBMR (e.g., http://nhso.med.navy.mil/ebhc2/Finding_Evidence/EBM.htm)
Commercial	CenterWatch clinical trials listing service	http://www.centerwatch.com	Thomson Medical Economics	Compiles industry and government-sponsored trials
Public	Clinical trials	http://clinicaltrials.gov	NIH	Lists current and recently closed trials
Professional	ACP Initiative on Lyme Disease	http://www.acponline.org/lyme/histstaff.htm	ACP-ASIM	Lists a phone number for obtaining a clinical reference guide on Lyme disease

NOTE. AAP, American Academy of Pediatrics; ACP, American College of Physicians; ASIM, American Society of Internal Medicine; CID, *Clinical Infectious Diseases*; EBMR, Evidence-Based Medicine Reviews; IDSA, Infectious Diseases Society of America; NIH, National Institutes of Health.

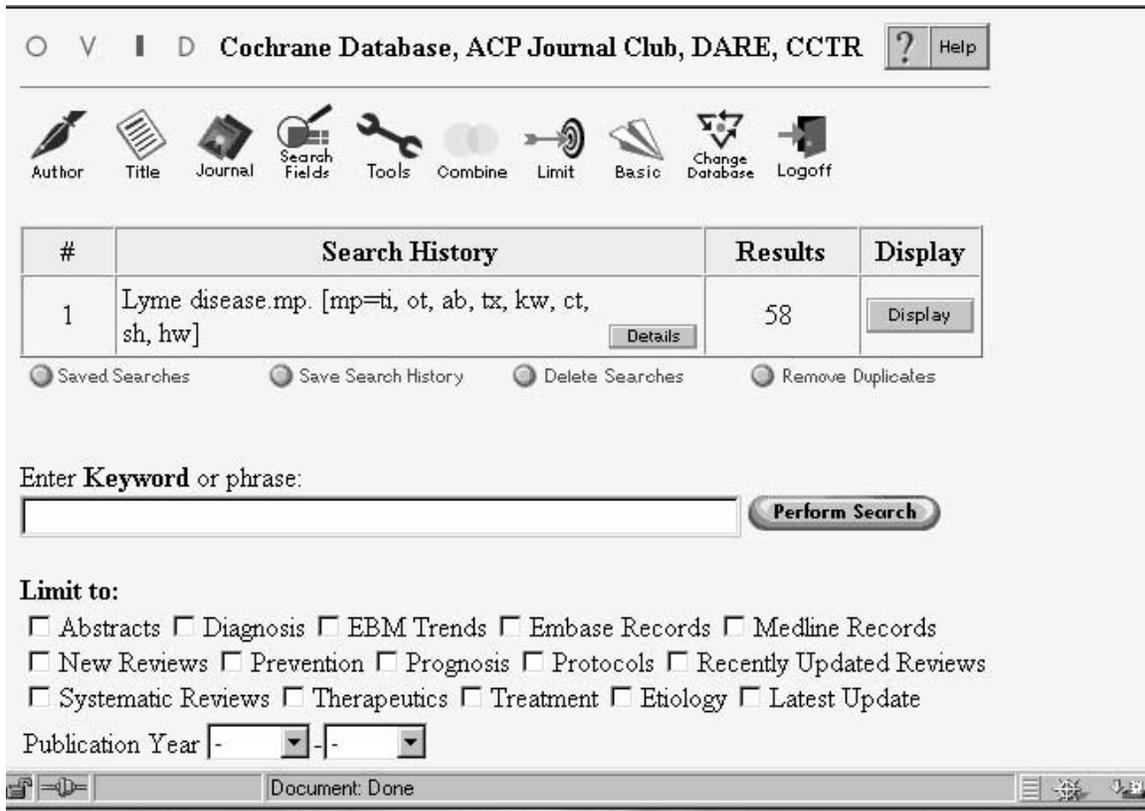


Figure 3. Ovid/Evidence-Based Medicine Reviews search page

tailed collection of tick images and factual information that serves as an excellent introduction to the field. *Ixodes scapularis* at various stages can be viewed via the CDC's Lyme disease home page, and good images of common ticks of medical importance are available on the American Lyme Disease Foundation and EUCALB Web sites. An illustrated life cycle of the deer tick is also accessible on the EUCALB site, and the biology of deer tick distributions is described on the CDC's Lyme disease home page under "Vector Ecology." There is an easy-to-access image collection that can be used for patient education purposes on Yahoo's health page.

Prevention. Sources of information about prevention of Lyme disease are listed in table 5. Although the only vaccine in use ceased to be marketed in March 2002, sites dealing with outer-surface protein A (OspA) vaccine continue to be relevant for information on its safety and efficacy and on the duration of immunity after vaccination. Several thousand adults and children were immunized with the licensed or with investigational OspA vaccines. The recommendations of the Advisory Committee on Immunization Practices for use of Lyme disease vaccine and for tick bite prophylaxis and management are published in MMWR and are available on-line from the CDC [11]. The American Academy of Pediatrics based its document largely on these recommendations. Vaccine-prescribing infor-

mation can still be accessed through the on-line *Physician's Desk Reference* (<http://www.pdr.net>) or the Web site of the OspA vaccine manufacturer (LYMERix OspA; GlaxoSmithKline). The American Lyme Disease Foundation has an insightful summary of OspA vaccine recommendations. The pivotal studies of OspA vaccine were published in *The New England Journal of Medicine* in 1998 [12, 13]. Data on pediatric use were published in *Pediatrics* in 2001 [14].

Research resources. Table 6 lists on-line resources for research on *Borrelia* and Lyme disease. The complete genome of *Borrelia burgdorferi*, first published in *Nature* in 1997 [15], is available as an on-line database and as maps at the Institute for Genomic Research Web site. The site is interactive, well structured, and well maintained. The National Center for Biotechnology Information's taxonomy browser offers a definitive list of *Borrelia* strains, with links to genomic records and protein structures. The Institut Pasteur has a promising resource in its *Borrelia burgdorferi* sensu lato Molecular Genetics Server. A drawback is that the site has not been updated recently. Maintenance appears to have been ignored, and several links do not work. Nevertheless, the strain lists of *Borrelia* species, DNA sequence lists, and gene-protein indices are comprehensive; the site presents an electrotransformation protocol in detail; and the references are exhaustive. The EUCALB site maintains fre-

Table 4. Web sources for information on tick identification and tick biology.

Source type	Title or subject	Address	Source name or publisher	Comment
Literature	"Medical Progress: Tick-Borne Diseases in the United States"	http://www.nejm.org	<i>The New England Journal of Medicine</i>	Color pictures and summary of diseases [9]
Literature	"Ticks and Tickborne Bacterial Diseases in Humans: An Emerging Infectious Threat"	http://www.journals.uchicago.edu/CID/journal/issues/v32n6/000509/000509.html	CID electronic edition	Exhaustive review of worldwide tick and disease distribution [10]
Professional	Tick biology	http://entomology.ucdavis.edu/faculty/rbkimsey/tickbio.html	University of California–Davis	Comprehensive collection of large color images with description
Public	Image of <i>Ixodes scapularis</i>	http://www.cdc.gov/ncidod/dvbid/lyme/4ticks_cm.htm	CDC DBVID	Tick size by stage
Patient education	Picture gallery of tick images	http://www.lyme.org/gallery/ticks.html	American Lyme Disease Foundation	Shows ticks other than <i>I. scapularis</i> for comparison
Professional	Images of ticks from the European Union	http://www.dis.strath.ac.uk/vie/LymeEU/images_entomology.html	EUCALB	Comprehensive guide
Professional	Illustration of tick life cycle	http://www.dis.strath.ac.uk/vie/LymeEU/images/lcylge.jpg	EUCALB	Life-cycle pictorial
Commercial	Tick, rash, and spirochete images	http://health.yahoo.com/health/dc/002856/tn.html	Yahoo.com	Rudimentary guide
Public	"Vector Ecology"	http://www.cdc.gov/ncidod/dvbid/lyme/history.htm	CDC DBVID	Provides understanding of tick distribution and Lyme disease risk

NOTE. CDC, Centers for Disease Control and Prevention; CID, *Clinical Infectious Diseases*; DBVID, Division of Vector-Borne Infectious Diseases; EUCALB, European Union Concerted Action on Lyme Borreliosis.

Table 5. Web sources for information on prevention of Lyme disease.

Source type	Title or subject	Address	Source name or publisher	Comment
Public	"Recommendations for the Use of Lyme Disease Vaccine"	http://www.cdc.gov/mmwr/preview/mmwrhtml/rr4807a1.htm (also accessible via the CDC Lyme disease home page)	ACIP/CDC	Detailed recommendations based on all available data on vaccine safety, efficacy, and epidemiology of the disease [11]
Professional	"Prevention of Lyme Disease"	http://www.aap.org/policy/re9942.html	AAP	Management of tick bite and vaccine use recommendations
Literature	Two OspA vaccine trials	http://www.nejm.org	<i>The New England Journal of Medicine</i>	[12, 13]
Literature	OspA vaccine in children	http://www.aap.org	<i>Pediatrics</i>	[14]
Patient education	Vaccine	http://www.aldf.com	ALDF	Summarizes OspA vaccine (GlaxoSmithKline) studies

NOTE. AAP, American Academy of Pediatrics; ACIP, Advisory Committee on Immunization Practices; ALDF, American Lyme Disease Foundation; CDC, Centers for Disease Control and Prevention; OspA, outer-surface protein A.

Table 6. Web resources for Lyme disease researchers.

Source type	Title or subject	Address	Source name or publisher	Comment
Commercial/professional	<i>Borrelia burgdorferi</i> complete genome	http://www.tigr.org/tigr-scripts/CMR2/GenomePage3.spl?database=gbb	Institute for Genomic Research	Full-color-coded, detailed map of all regions
Public	Taxonomy browser	http://www.ncbi.nlm.nih.gov/htbin-post/Taxonomy/wgetorg?name=Borrelia	NCBI	Systematic classification of genus <i>Borrelia</i>
Professional	<i>Borrelia burgdorferi</i> sensu lato Molecular Genetics Server	http://www.pasteur.fr/recherche/borrelia/Welcome.html	Institut Pasteur	Comprehensive, updated 1999
Professional	EUCALB information	http://www.dis.strath.ac.uk/vie/LymeEU/biology_spiro-borrelia-strains.html	EUCALB	Comprehensive summary of current knowledge on all strains, including European species
Commercial	CenterWatch Clinical Trials Listing Service	http://www.centerwatch.com	Medical Economics Company	Lists industry and government-sponsored trials
Public	ClinicalTrials.gov	http://clinicaltrials.gov	NIH and FDA	Current and recent clinical trials

NOTE. EUCALB, European Union Concerted Action on Lyme Borreliosis; FDA, US Food and Drug Administration; NCBI, National Center for Biotechnology Information; NIH, National Institutes of Health.

Table 7. Web-based literature retrieval services useful for Lyme disease.

Source type	Title or subject	Address	Source name or publisher	Comment
Literature	MEDLINE	http://www.ncbi.nlm.nih.gov/PubMed	NLM MEDLINE	
Patient education/literature	MEDLINEplus on Lyme disease	http://www.nlm.nih.gov/medlineplus/lymedisease.html	NLM consumer service	Useful for NIH news releases, such as results of recent chronic Lyme disease treatment trial
Literature	Medical Matrix	http://www.Medmatrix.org	Medical Matrix	Comprehensive, user-friendly, requires free registration
Literature	Merck Medicus	http://www.Merckmedicus.com	Merck	Comprehensive, user-friendly, requires no registration
Literature	EBMR	http://gateway1.ovid.com/ovidweb.cgi (accessed via local medical center library's Web site)	Ovid Technologies	Several other Web sites offer access to EBMR (e.g., http://nhso.med.navy.mil/ebhc2/Finding_Evidence/EBM.htm)
Public	National Guideline Clearinghouse	http://www.guideline.gov/index.asp	Agency for Healthcare Research and Quality	Evidence-based clinical practice guidelines, offers auto-updates by e-mail

NOTE. EBMR, Evidence-Based Medicine Reviews; NIH, National Institutes of Health; NLM, National Library of Medicine.

quently updated, in-depth lists of published studies. EUCALB's consultants are clearly listed, links are judiciously chosen, and the site was updated in December 2001. Information for referral of patients to ongoing clinical research trials is available at the NIH and CenterWatch clinical trial Web sites.

Literature search services and other compendia. Repeated searches performed on popular search engines sites such as AltaVista, Google, Excite, and Lycos confirmed that this search strategy is a far from optimal method of obtaining sites useful for medical and research purposes. Use of the search term "Lyme disease" is a little more likely to yield sites with scientifically sound information than use of "Lyme" alone (probably because the latter is a common lay term also used to describe symptom complexes in patients who have no serologic evidence of the infection); "Lyme" yielded ~537,000 sites, compared with 215,000 for "Lyme disease." After using the sites reviewed in this article, physicians should periodically augment their information on Lyme disease by registering (free of charge) with one of several Web sites that compile databases of scientific information. A recent visit to the clinical resources section of one site (Medscape) yielded a mixed bag, but the Lyme disease page in the Medscape Resource Center (<http://www.medscape.com/pages/editorial/resourcecenters/public/lymedisease/rc-lymedisease.ov>) was sound. Some services that provided links to Lyme disease information are listed in table 7 (along with the better-known National Library of Medicine's MEDLINE); on a recent visit to the National Guideline Clearinghouse Web site, for example, 9 documents on Lyme disease were found, including "Guidelines for laboratory evaluation in the diagnosis of Lyme disease" [16], an *Annals of Internal Medicine* position paper that is also accessible via the ACP Web site (<http://www.acponline.org/journals/annals/15dec97/pplyme1.htm>).

CONCLUSIONS

The World Wide Web has a plethora of material on Lyme disease, but extracting medically and scientifically useful information requires more than casual browsing. The optimal strategy involves bookmarking a few key sites to start a search for information and using a combination of these sites and literature search services that mine the Web for evidence-based recommendations and summaries (tables 3 and 7). Key journals for infectious diseases, internal medicine, and pediatrics should be among the primary sources of diagnostic, therapeutic, preventive, and molecular research information on Lyme disease. The best all-around initial sources of information include the CDC's home page on Lyme disease and the EUCALB Web site, which also has the most comprehensive image collection of clinical manifestations. The best private organization-based site

that can be recommended to patients for education on Lyme disease is that of the American Lyme Disease Foundation, which has easy-to-read and elegantly formatted pages. Perhaps the most useful feature of the Web for treatment and prevention of Lyme disease is access to evidence-based practice guidelines, which infectious diseases physicians should periodically consult for updates.

Acknowledgment

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